

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 14 MAR 2006
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Applicant's or agent's file reference BPX 10051	<div style="text-align: center;">FOR FURTHER ACTION</div> <div style="text-align: right;">See Form PCT/IPEA/416</div>	
International application No. PCT/GB2004/004988	International filing date (day/month/year) 25.11.2004	Priority date (day/month/year) 18.12.2003
International Patent Classification (IPC) or national classification and IPC F25J3/02, F17C9/04		
Applicant BP EXPLORATION OPERATING COMPANY LIMITED et al.		
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p style="margin-left: 20px;">a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 3 sheets, as follows:</p> <p style="margin-left: 40px;"><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p style="margin-left: 40px;"><input checked="" type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p style="margin-left: 20px;">b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>		
<p>4. This report contains indications relating to the following items:</p> <p style="margin-left: 20px;"><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p style="margin-left: 20px;"><input type="checkbox"/> Box No. II Priority</p> <p style="margin-left: 20px;"><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p style="margin-left: 20px;"><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p style="margin-left: 20px;"><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p style="margin-left: 20px;"><input type="checkbox"/> Box No. VI Certain documents cited</p> <p style="margin-left: 20px;"><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p style="margin-left: 20px;"><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>		
Date of submission of the demand 15.07.2005	Date of completion of this report 13.03.2006	
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Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

Description, Pages

1-6 as originally filed

Claims, Numbers

1-11 as originally filed

Drawings, Sheets

1/1 as originally filed

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

4. ☒ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages
- ☒ the claims, Nos. 1-13
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	2,9,11
	No: Claims	1,3-8,10
Inventive step (IS)	Yes: Claims	-
	No: Claims	1-11
Industrial applicability (IA)	Yes: Claims	1-11
	No: Claims	-

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item I

1. The amendments filed with the letter dated 03.10.2005 introduce subject-matter which extends beyond the content of the application as filed, contrary to Article 34(2)(b) PCT. The amendments concerned are the following:
 - 1.1 Claim 1 has been amended to include the feature that *at least a major portion of the feed stream of liquefied natural gas is vaporised in step (i) by heat exchange of at least part of the feed stream of liquefied natural gas with the compressed gas stream from step (ii) or (iii) and with the stream rich in methane from step (v).*
 - 1.2 The applicant argued that the basis for this amendment is to be found in the figure. However this point of view cannot be accepted as the figure merely discloses that heat is exchanged in the heat exchanger 4 between the three streams, i.e. pumped LNG stream and streams 9 and 13, but not that *at least a major portion of the liquefied natural gas is vaporised*. Moreover, it would even appear that the description teaches that no LNG at all is vaporised in the exchanger 4, as it is "the LNG", i.e. the Liquefied Natural Gas, which is carried to the separation vessel 6 after being heated in exchanger 4, see page 6, first line.
 - 1.3 Hence, the reasoned statement of this report according to Article 35(2) PCT is based on the claims as originally filed.

Re Item V

2. Reference is made to the following documents:
 - D1: US-A-3 837 821
 - D2: US-B1-6 604 380
 - D3: GB-A-1 261 457
 - D4: US-B1-6 564 579
3. The document D1 is regarded as being relevant prior art to the subject-matter of independent claim 1 and discloses (the references in parentheses applying to figure 1 of this document):

A process for the conditioning of liquefied natural gas, which comprises applying the following steps to a feed stream of liquefied natural gas:

 - i) vaporizing (4,6,8,10) at least a major portion of the feed stream of liquefied natural gas to produce an at least partially vaporized natural gas stream;
 - ii) separating (13) the at least partially vaporized natural gas stream to produce a first

stream (42) which is rich in methane and a second stream (14) which is rich in hydrocarbons having two or more carbon atoms;

iv) cooling the gas stream from step (ii) by heat exchange (6) with at least part of the feed stream of liquefied natural gas to produce a liquid gas stream (28);

v) passing (14) the second stream from step (ii) without pumping to a distillation vessel (16) to produce a natural gas liquids stream (35) and a stream (17) rich in methane, the operating pressure of the distillation vessel being such that the stream rich in methane exits the distillation vessel at a pressure in the range of from 2 to 6 barg (7 bar absolute);

vi) cooling (4) the stream rich in methane from step (v) by heat exchange with at least part of the feed stream of liquefied natural gas and subsequently pumping (26) to produce a liquid compressed gas stream (27);

vii) combining the liquid compressed gas streams (28,27) from steps (ii) and (vi)

viii) vaporizing (31) the liquid compressed gas streams from steps (iv), (vi) and (vii)

ix) to produce a conditioned natural gas (33) and

x) recovering the natural gas liquids (41,39).

Therefore the subject-matter of **claim 1** is not novel (Article 33(2) PCT).

4. Dependent claims 2 to 11 do not contain any features which, in combination with the features of any claim to which it refers, meet the requirements of the PCT in respect of novelty and/or inventive step (Article 33(3) PCT). The reasons being as follows:
- 4.1 The additional features of **claims 3 to 8 and 10** are already known from the method disclosed in D1 (Reference is made to the citations of the International Search Report).
- 4.2 The additional features of **claims 2 and 9** are not disclosed by the above publication, but they represent merely an optimisation of the process of D1 which comes within the scope of the customary practice followed by persons skilled in the art. It is generally known to the persons skilled in the art that the ultimate choice of the feed pressure as well as the pressure within the rectification column may be done after a rational procedure of optimisation, involving both theoretical calculations and practical tests. Therefore, such an optimisation cannot be regarded as inventive.
- 4.3 In D1 it is not mentioned that plate-fin exchangers are used in the manner claimed in **claim 11**. However this feature is merely one of several straightforward possibilities from which the skilled person would select, in accordance with circumstances (particularly due to the relatively low pressure used), without the exercise of inventive skill, in order to

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realize the process of D1 using the well known technology of plate-fin exchangers. The additional feature of said claim therefore does not go beyond the normal way of working in the art.

Claims

1. A process for the conditioning of liquefied natural gas, which comprises applying the following steps to a feed stream of liquefied natural gas:
 - i. vaporizing at least a major portion of the feed stream of liquefied natural gas to produce an at least partially vaporized natural gas stream;
 - 5 ii. separating the at least partially vaporized natural gas stream to produce a first stream which is rich in methane and a second stream which is rich in hydrocarbons having two or more carbon atoms;
 - iii. if required, compressing the first stream from step (ii) to increase the pressure and produce a compressed gas stream;
 - 10 iv. cooling the compressed gas stream from step (ii) or (iii) by heat exchange with at least part of the feed stream of liquefied natural gas to produce a liquid compressed gas stream;
 - v. passing the second stream from step (ii) without pumping to a distillation vessel to produce a natural gas liquids stream and a stream rich in methane,
 - 15 the operating pressure of the distillation vessel being such that the stream rich in methane exits the distillation vessel at a pressure in the range of from 2 to 6 barg;
 - vi. cooling the stream rich in methane from step (v) by heat exchange with at least part of the feed stream of liquefied natural gas and subsequently
 - 20 pumping to produce a liquid compressed gas stream;
 - vii. optionally combining the liquid compressed gas streams from steps (ii) or (iii) and (vi);
 - viii. vaporizing the liquid compressed gas streams from steps (iv), (vi) and/or (vii) to

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- ix. produce a conditioned natural gas; and
- 5 x. recovering the natural gas liquids
- wherein at least a major portion of the feed stream of liquefied natural gas is vaporized in step (i) by heat exchange of at least part of the feed stream of liquefied natural gas with the compressed gas stream from step (ii) or (iii) and with the stream rich in methane from step (v).
- 10 2. A process as claimed in claim 1, in which in step (v) the stream rich in methane exits the distillation vessel at a pressure in the range of from 3 to 5 barg.
3. A process as claimed in either claim 1 or claim 2, in which the separation of step (ii) is carried out using a separator with no reflux streams and containing no packing materials or gas-liquid separation trays.
- 15 4. A process as claimed in any one of claims 1 to 3, in which the distillation column used in step (v) contains gas-liquid separation packing or trays and is operated without the presence of a reflux stream.
5. A process as claimed in any one of claims 1 to 4, in which in excess of 90% of the feed stream to the process is processed in step (i), none of said feed stream
- 20 being used to act as a reflux in any column used in the process.
6. A process as claimed in any one of claims 1 to 5, in which the stream rich in methane from step (v) is cooled by heat exchange with at least part of the feed stream of liquefied natural gas and is subsequently pumped to equalise its pressure with that of the liquid compressed gas stream produced in step (iv), and the two
- 25 streams are combined.
7. A process as claimed in claim 6, in which said combined stream is pumped to increase the pressure and subsequently vaporized.
8. A process as claimed in any one of claims 1 to 7, in which the distillation vessel in step (ii) is provided with a reboiler which uses seawater as coolant.
- 30 9. A process as claimed in any one of claims 1 to 8, in which the input pressure of the at-least partially vaporized natural gas stream into step (ii) is in the range of from 9 to 13 barg.

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5 10. A process as claimed in claim 9, in which the pressure of the compressed gas stream produced in step (iii) is increased by from 2 to 5 bar.

11. A process as claimed in claims 9 or 10, in which the liquid compressed gas stream from step (iv) is at a pressure of 12 to 16 barg.

12. A process according to any one of claims 1 to 11, in which the temperature of
10 the feed stream of liquefied natural gas is in the range of from -170 to -150°C.

13. A process as claimed in any one of claims 1 to 12, in which the heat exchanger(s) used in steps (ii)/(iii) and (v) is/are a plate-fin exchanger(s).

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